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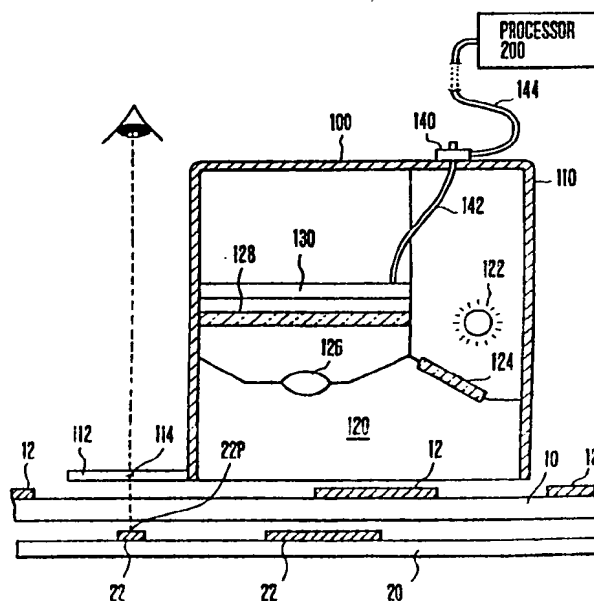
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Inventor: **Ichinokawa, Kazuo**, NEC Overseas Marketing, Ltd. 7-15, Shiba 5-chome, Minato-ku Tokyo (JP)(64) Designated Contracting States: **DE FR GB IT NL**(74) Representative: **Pears, David Ashley et al, REDDIE & GROSE** 16 Theobalds Road, London WC1X 8PL (GB)(54) **Optical digitizer.**

(57) A cursor device (100) is movable manually over a transparent plate (10) beneath which can be disposed a document (20) bearing markings (22) to be traced by an index mark (114) in a projecting arm (112). A cursor device (100) is thereby positioned relative to fluorescent markings (12) on the transparent plate (10). The fluorescent markings are illuminated by light of one wavelength from a source (122) and a filter (124) in a housing (110) of the cursor device. Fluorescent light thereby stimulated is collected by a lens (126) passed by a filter (128) and received by a charge coupled device sensor (130). When a switch (140) is operated to complete a circuit, the signals from the charge coupled device (130) are passed to a processor (200) which can determine the position and orientation of the cursor device (100) because of the distinctive pattern information in the fluorescent markings (12).



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OPTICAL DIGITIZER

The present invention relates to an optical digitizer for determining positions of graphic data described on a recording medium such as a paper sheet.

Hitherto, a large number of position co-ordinates reading or recognizing devices called "digitizers" or "data tablets" have been commercialized. Such devices are operative to detect position co-ordinates at the time designated by a cursor slidable on a planar member. They find wide application in devices for inputting figures or characters into a computer. The above-mentioned position co-ordinates represent co-ordinate values designated by a lateral (X-axis) co-ordinate position and a longitudinal (Y-axis) co-ordinate position. For conventional digitizers, there have been proposed a system of utilizing electrostatic coupling or electromagnetic coupling, a system of utilizing voltage dividing ratio by resistors, a

system of utilizing a magnetostriction phenomenon, and a system of utilizing ultrasonic wave etc. Among these systems, the digitizers of magnetostriction system have been widely utilized. They are configured so as to allow
5 magnetostrictive pulses to be periodically propagated on a metal plate from the upper edge and the lefthand edge thereof to detect the propagation of the magnetostrictive pulses by means of a coil attached to a cursor, thereby calculating a propagation time of the magnetostrictive
10 pulses to determine coordinates. Such a propagation time is determined based on a counted value of a counter circuit. Usually, the propagation speed of the magnetostrictive pulse is approximately 5000 m/sec. Accordingly, it is necessary to operate the counter
15 circuit using a clock having about 100 MHz in order to obtain position coordinates with an accuracy of 0.1 mm.

However, the drawback with the above-mentioned digitizers of magnetostriction system are as follows. It is difficult to miniaturize a circuit for generating
20 magnetostrictive pulse. Further, an excessive increase in an area of the planar member results in lowering of accuracy. Accordingly, the planar member must have a limited area. This makes it difficult to cover a wide data surface to be digitized. In addition,
25 magnetostrictive pulses generate a large electromagnetic wave noise. In particular, when the digitizer is used in an office, the electromagnetic wave noise becomes a large

noise source with respect to a private communication network, giving rise to communication fault.

To further consider problems with such a magnetostrictive digitization, a proposed digitizer shown
5 in USP No. 3,904,821 will be briefly described. The coordinate digitizer comprises a data surface provided with a magnetostrictive sheet serving as nondirection transmission media, and vertical and horizontal wire conductors forming a field generating device positioned
10 along the coordinate edges of the data surface. The coordinate digitizer further comprises trigger means for triggering the production of a magnetic field by the field generating device, and a pick-up device coupled to the transmission media and responding to the propagating
15 vibrational mode for providing a signal to circuit means which will respond to the trigger means and to the pick up device in order to provide a position signal corresponding to the time of propagation of the vibrational mode from its time of generation to its time of pick-up.

20 The above-mentioned coordinate digitizer effects position determination by making use of propagation of a vibrational mode of longitudinal line strain wave across the entire axis of the nondirectional transmission media, thus providing improved operation and configuration as
25 compared to previously proposed other digitizers operable based on the magnetostirictive principle. However, the aforesaid drawbacks generally encountered in conventional

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co-ordinate digitizers of this kind could not be solved by the digitizer disclosed in US Patent No. 3,904,821. Namely, the last-mentioned digitizer also required a pulse generator for triggering the field generating device, which is difficult to be small sized. Also, there is a limit in regard to the size of the magnetostrictive sheet from a viewpoint of accuracy. Further, the employment of the magnetostrictive pulse results in occurrence of electromagnetic wave noise.

With the above in view, an object of the present invention is to provide an improved optical digitizer which eliminates the drawbacks explained above, in particular a small-sized digitizer of improved accuracy, the digitizer being free from the influence of electromagnetic wave noise.

According to the present invention, there is provided an optical digitizer as defined in claim 1 below.

More specifically, the invention provides an optical digitizer comprising a light active surface located above a graphic data recording medium, the light active surface comprising light emitting regions arranged so as to define a co-ordinate correlative pattern; and optical recognition means movable on the light active surface, the optical recognition means comprising first means which can be visually traced over data on the recording medium in accordance with

movements of the optical recognition means, thereby to effect positioning of the optical recognition means with respect to the data location, an optical system adapted to irradiate the light active surface, and sensing means adapted to sense light having a wavelength different from that of irradiating light and emitted from a part of the co-ordinate correlative pattern falling within a field of view of the optical recognition means, thereby to produce a corresponding electric signal, on the basis of which computation may be effected to determine position co-ordinates of the graphic data on the recording medium.

The graphic data recording medium may be a paper sheet on which figures or characters are described. The light active surface may be composed of a transparent flat plate of plastic etc. on or in which the co-ordinate correlative pattern is described with a fluorescent paint. The co-ordinate correlative pattern is capable of emitting fluorescent light in response to the irradiating light from the second means, the fluorescent light having a wavelength longer than that of the irradiating light.

The optical recognition means may be configured as a cursor movable on the flat plate, the cursor being provided with a hollow casing member having an opening

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opposing the surface of the flat plate. The first means may be composed of a positioning arm having a crucial mark, provided on the outer periphery of the hollow casing member of the cursor.

The optical system constituting the second means may comprise a light source emitting the irradiation light, and an optical filter having an optical characteristic to cut off light having a wavelength longer than that of the fluorescent light.

The third means may comprise a sensor unit in which a charge coupled sensor is assembled. The optical system constituting the second means may further comprise a convex lens and a second optical filter having an optical characteristic to cut off light having a wavelength shorter than that of the fluorescent light, the convex lens and the second optical filter being provided in an optical path of the fluorescent light to the charge coupled sensor.

The optical recognition means may further comprise a switch provided on the hollow casing member, a first cable connecting the sensor unit to the switch, and a second cable connecting the switch to a graphic data processor.

The light source may be a light emitting diode of GaP which emits light having a peak luminance at a wavelength of 555 nm.

The first optical filter may then have an optical

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characteristic to cut off light having a wavelength longer than 570 nm. The fluorescent paint may be Rhodamine B having an absorption peak at a wavelength of 550 to 560 nm and a luminance peak of the fluorescent light at a wavelength of about 590 nm. The second optical filter may then have an optical characteristic to cut off light having a wavelength shorter than 570 nm.

In another form of the optical recognition means, the second means may comprise a set of light sources irradiating fluxes of light having the same wavelength, and a set of optical filters having an optical characteristic to cut off light having a wavelength longer than that of the set of light sources. The third means further comprises a semiconductor memory for temporarily storing image information sensed by the sensor unit.

↓
The co-ordinate correlative pattern may be provided in the form of lattice defined by a plurality of longitudinal and lateral straight lines intersecting with each other, both spacings between longitudinal lines and those between lateral lines being set at integral multiples of a unit length. For performing optical encoding, binary digits (ones and zeros) are assigned to respective co-ordinate locations corresponding to the integral multiples of the unit length in the longitudinal and lateral directions of the lattice pattern depending upon whether the longitudinal and lateral lines exist or not at the respective co-ordinate locations, thus to express the

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respective co-ordinate locations by code sequence defining an M-sequence which is created by a circulating shift register. ↑

The optical digitizer is operative to execute a processing comprising the steps of finding out data indicative of an arbitrary single straight line from the projecting image data corresponding to the partial pattern optically recognized by the second means to calculate the rotational angle with respect to the longitudinal or lateral line within the visual range using the data indicative of the arbitrary single straight line, calculating respective spacings between a plurality of longitudinal and lateral lines within the visual range to determine a corresponding successive N bit code from the respective spacings thus calculated to find out a section to which the center of the visual range belongs, thus to calculate position co-ordinates of the center of the visual range. The processing further comprises a step of determining position co-ordinates of the graphic data recording medium by using a distance between the center of the visual range and a predetermined position of the first means, the rotational angle, and the position co-ordinates of the center of the visual range. Such a processing is periodically executed only while the optical recognition means and the processor are electrically coupled.

The features and advantages of an optical

digitizer according to the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a schematic representation illustrating an embodiment of an optical digitizer according to the present invention;

Fig. 2 is a plan view for explaining positioning of optical recognition means with respect to data location in the optical digitizer shown in Fig. 1;

Fig. 3 shows characteristic curves of monochromatic light spectrum of a light source and a fluorescent spectrum for a pattern employed in the present invention, respectively;

Fig. 4 shows characteristic curves of short-pass and short-cut optical filters employed in the present invention, respectively;

Fig. 5 is a schematic view showing an example of a pattern employed in the present invention, the pattern being described with a fluorescent paint;

Fig. 6 is a circuit diagram illustrating an example of a circulating shift register for creating M-sequence employed in the present invention; and

Fig. 7 is a schematic representation illustrating another embodiment of an optical digitizer according to the present invention.

Detailed Description of Preferred Embodiments

Preferred embodiments of the optical digitizer

according to the present invention will be described with reference to attached drawings.

Fig. 1 is a schematic side view showing a first preferred embodiment of the invention. The optical digitizer implemented in this embodiment comprises a transparent flat plate 10 of plastic etc. forming a light active surface located above a graphic recording medium 20, and a cursor 100 functioning as an optical reader or an optical recognition device movably mounted on the flat plate 10. The transparent flat plate 10 comprises light emitting media e.g. fluorescent media arranged so as to form a predetermined coordinate correlative pattern 12. More particularly, the coordinate correlative pattern 12 is described on or in the flat plate 10 with a fluorescent paint diffused into transparent polymer. The graphic recording medium 20 may be a paper sheet on which figures or characters labelled 22 are described.

The optical recognition device 100 as the cursor has a hollow casing member 110 serving as a black box with respect to an optical system assembled therein, which will be described later. The casing member 110 has an opening opposite the surface of the flat plate 10. A transparent positioning arm 112 extending in a lateral direction is provided on the outer periphery of the casing member 110. The positioning arm 112 is provided in the middle position thereof with a crucial mark 114. The provision of the positioning arm 112 allows an operator to visually trace a

graphic data location on the recording medium 20 in accordance with a movement of the cursor 100, thus to effect positioning of the cursor 100 with respect to the graphic data location.

5 The optical recognition device 100 further comprises an optical system 120 assembled within the casing member 110. The optical system 120 comprises a light source 122, a first optical filter 124 positioned between the light source 122 and the pattern 12 of the
10 flat plate 10, and a light focusing convex lens 126 and a second optical filter 128 which are positioned between the pattern 12 of the flat plate 10 and a sensor unit to be referred to soon. These members 122, 124, 126 and 128 constituting the optical system will be described later in
15 greater detail.

 The optical recognition device 100 further comprises a sensor unit 130 having a two-dimensional CCD (charge coupled device) assembled within the casing member 110, a switch 140 provided on the casing member 110, a
20 first signal line cable 142 connecting the sensor unit 130 to the switch 140, and a second signal line cable 144 connecting the switch 140 to a graphic data processor 200. Thus, the sensor unit 130 is operative to sense light emitted from a partial pattern which falls within a
25 predetermined limited visual range of the coordinate correlative pattern 12 to produce a corresponding electric signal, thereby effecting computation based on the

electric signal in the graphic data processor to determine position coordinates of the graphic data on the coordinate medium. The above-mentioned crucial mark 114 is provided for positioning a certain figure 22 (a graphic data) described on the paper sheet 20 when visually tracing figures 22 in order to obtain graphic information of the figures 22. In the embodiment, the flat plate 10 is placed on the paper sheet 20 on which figures 22 to be inputted are drawn. Thus, the position coordinates at a point 22P of a figure 22 is determined by moving the cursor 100 on the flat plate 10 so that the point 22P of the figure 22 is in register with the crucial mark 114 of the positioning arm 112 provided on cursor 100. Such a positioning viewed from the upward direction is shown in Fig. 2 wherein an indication of the pattern 12 is omitted for eliminating complexity.

A method of determining position coordinates on the flat plate 10 indicative of the point 22P will be described below. As previously described, the optical system 120 provided within the hollow casing member 110 as the black box is provided with the light source 122. The light source 122 may be a light source which emits a substantially monochromatic light having a luminance peak at a wavelength of λ_0 . A characteristic curve a in Fig. 3 indicates a spectrum of light irradiated from such a light source 122. For instance, a light emitting diode of GaP (gallium-phosphorus) may be used as the light

source 122. The light emitting diode of GaP has a luminance peak at a wavelength of 555 nm (nano meter). Light irradiated from the light source 122 passes through the first optical filter 124 having a transmission

5 characteristic as indicated by a characteristic curve b in Fig. 4 (e.g. a characteristic to cut off light having a wavelength longer than 570 nm when the above-mentioned LED is used) to irradiate the flat plate 10 having the pattern 12 and the paper sheet 20 positioned below. In view of

10 the above nature, the first optical filter 124 will be referred to as a short-pass filter hereinafter. As described above, the pattern 12 is described with a fluorescent paint which has a peak of optical energy absorption at a wavelength of λ_0 to emit a fluorescence

15 having a peak at a wavelength λ_1 (λ_0) based on the absorbed optical energy. A characteristic curve c in Fig. 3 shows a spectrum of such a fluorescence. By way of example, Rhodamine B may be used as the fluorescent paint, which has a peak of absorption at a wavelength of 550 to

20 560 nm, and a luminance peak of the output fluorescence at a wavelength of about 590 nm. In this embodiment, most of components of wavelength λ_0 of the light are reflected at white portions on the paper sheet 20 where figures 22 are not drawn. On the other hand, most of components of

25 wavelength λ_0 of the light are absorbed at black portions where figures 22 are drawn. The second optical filter 128 has a transmission characteristic as indicated

by d in Fig. 4 (e.g. a characteristic to cut off light of a wavelength shorter than 570 nm when the above-mentioned LED and Rhodamine B are used). In view of the above nature, the second optical filter 128 will be referred to as a short cut filter thereafter. It is apparent from this characteristic that light which has passed through the filter 124 and then has been scattered and reflected within the black box 110 is cut off by the filter 128, with the result that the light does not arrive at the CCD sensor unit 130. In contrast, since the fluorescence having the wavelength λ_1 emitting from the pattern 12 passes through the filter 128 via the convex lens 126, only the pattern 12 is projected as a positive image on the CCD sensor unit 130. The requirement of the pattern 12 drawn with a fluorescent paint on the flat plate 10 is as follows. When optically recognizing a partial pattern which falls within a limited visual range of the pattern 12, an arbitrary pattern may be used as far as position coordinates in the center of the partial pattern and a rotational angle of the visual range can be calculated.

Fig. 5 shows a partially enlarged view of an example of the pattern 12, e.g., a lattice pattern. The spacings between longitudinal lines and those between lateral lines are set at a multiple of integer of unit length e.g. 1 mm. Apparently, these lines are drawn at random. It is now assumed that binary digits ("1" and "0") are assigned to respective coordinate locations

corresponding to the multiple of integer of 1 mm in the longitudinal and lateral directions of the lattice pattern depending upon whether the longitudinal and lateral lines are present or absent at the respective coordinate locations, thus to express the respective coordinate locations by code sequence. In this embodiment, code sequence of the above nature may be M-sequence (maximum period sequence). Such M-sequence can be created by means of a circulating shift register as shown in Fig. 6. The circulating shift register comprises four stage cascade connected J-K flip-flops 60 to 63, an AND gate 64, an inverter 65, and a clock feed line 67. The M-sequence output from the AND gate 64 is defined by repetition of a bit pattern having a fifteen-bit length as expressed by 110110010100001. This sequence is characterized in that successive four bits are different from each other, respectively. Namely, when a selection of successive four bits in order from the leftmost bit of the above-mentioned bit sequence is made to obtain fifteen kinds of four bit codes different from each other, as indicated by (1101), (1011), (0110), (1100), (1001), (0010), (0101), (1010), (0100), (1000), (0000), (0001), (0011), (0111), and (1110). In general, the M-sequence created by N stages of shift registers are defined by repetition of a bit pattern having (2^N-1) bit length, thus creating (2^N-1) kinds of four successive N bit codes different from each other. By making use of this nature of the M-sequence, it is

possible to obtain position coordinates and a rotational angle of the black box 110 on the flat plate 10 in accordance with a method described below. In Fig. 5, a square 14 as indicated by a dotted line shows an example of a visual range of the black box 110 projected on the two-dimensional CCD sensor unit 130. From a partial pattern which falls within the visual range, it is possible to calculate position coordinates and a rotational angle of the center 16 of the visual range 14.

10 Namely, first is to find out an arbitrary single straight line from a partial pattern read by the two-dimensional CCD sensor unit 130. In this instance, it is possible to calculate an angle θ of the straight line with respect to a longitudinal or lateral line within the visual range 14

15 with ease. Second is to calculate spacings between longitudinal lines and these between lateral lines within the visual range 14, thereby to determine a corresponding successive four bit code of the M-sequence, thus determining a section or division to which the center 16

20 belongs. Precise position coordinates of the center 16 within the center 14 are determined by calculating distances from the center 16 to the respective nearest longitudinal and lateral lines. Since the distance from the center 16 within the visual range 14 of the sensor

25 unit 130 to the crucial mark 114 is a constant value which can be known in advance, it is possible to easily obtain position coordinates from the above distance, the

rotational angle θ and the position coordinates of the center 16. The above-mentioned calculation is executed by the graphic data processor 200 connected to the black box 110 through the cable 144. Such a processing is
5 periodically effected only for a time period during which the cables 142 and 144 are electrically connected by the switch 140.
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Then, a second preferred embodiment of an optical digitizer according to the present invention will be
10 described with reference to Fig. 7. The elementary configuration of this embodiment is similar to that of the first-mentioned embodiment. This embodiment is characterized in that a set of light sources 122A and 122B irradiating light fluxes having the same wave length λ_2
15 are provided instead of the single light source 122, in that a set of short-pass filters 124A and 124B having an optical characteristic to allow light having a wavelength shorter than λ_3 ($> \lambda_2$) to pass therethrough are provided instead of the single cut-pass filter 124, in
20 that a semiconductor memory 132 is added to temporarily store image information sensed by the sensor unit 130, and in that fluorescent paint for the pattern 12 emitting fluorescent light having a wavelength longer than λ_4 ($> \lambda_3$) is used.

25 An image of a partial pattern which falls within a predetermined visual range of the pattern 12 focused on the sensor unit 130 through the convex lens 126 and the

short-cut filter 128 is sensed by the sensor unit 130 as a positive image. Thus, information of the partial pattern corresponding thereto is stored in the semiconductor memory 132. The information of the image temporarily
5 stored in the semiconductor memory 132 is fed to the graphic information processor 200 (not shown herein) via the cable 144, and then the information is processed therein in a manner similar to the method as described in the first embodiment.

10 As stated above, the novel optical digitizer according to the present invention can realize size reduction, improvement of accuracy and elimination of influence of electromagnetic noise.

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CLAIMS

1. An optical digitizer, comprising a light active surface (10) located, in use, above a graphic data recording medium (20), the light active surface comprising light emitting regions (12) arranged so as to define a pattern; and means (100) having a light irradiating (122) and sensing (130) function movable on the light active surface, the pattern (12) on the light active surface (10) being responsive to irradiating light from the said means to emit light having a wavelength different from that of the irradiating light, thereby to determine position co-ordinates of graphic data on the recording medium on the basis of the light sensed by the said means.
2. An optical digitizer as set forth in claim 1, characterised in that the pattern is configured as an array of fluorescent regions (12) emitting fluorescent light having a wavelength longer than that of the irradiating light.
3. An optical digitizer comprising a light active surface (10) located, in use, above a graphic data recording medium (20), the light active surface comprising light emitting regions (12) arranged so as to define a co-ordinate correlative pattern; and optical recognition means (100) movable on the light active surface, the optical recognition means comprising first means (112,114) which can be visually traced over data (22) on the recording medium (20) in accordance with movements of the optical recognition means, thereby to effect positioning of the optical recognition means with respect to the data (22); an optical system (122,124) adapted to irradiate the light active surface (10); and sensing means (128,130) adapted to sense light having a wavelength different from that of the irradiating light and emitted from a part of the co-ordinate correlative pattern falling within a field of view of the optical recognition means (100), thereby to produce a corresponding electric signal on the basis of which computation may be effected to determine position co-ordinates of the graphic data on the recording medium.

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4. An optical digitizer as set forth in claim 3, characterised in that graphic data recording medium (20) is a paper sheet on which figures or characters (22) are described.
5. An optical digitizer as set forth in claim 3 or 4, characterised in that the light active surface is composed of a transparent flat plate (10) on or in which the co-ordinate correlative pattern (12) is described with a fluorescent paint.
6. An optical digitizer as set forth in claim 5, characterised in that the fluorescent paint is Rhodamine B having an absorption peak at a wavelength of 550 to 560 nm and a luminance peak of the fluorescent light at a wavelength of about 590 nm.
7. An optical digitizer as set forth in claim 5 or 6, characterised in that the co-ordinate correlative pattern (12) is capable of emitting fluorescent light in response to the irradiating light from the optical system, the fluorescent light having a wavelength longer than that of the irradiating light.
8. An optical digitizer as set forth in claim 5, 6 or 7, characterised in that the optical recognition means (100) is configured as a manually positionable cursor device movable on the flat plate (10), the cursor device being provided with a hollow casing (110) having an opening over the surface of the flat plate.
9. An optical digitizer as set forth in claim 8, characterised in that the first means is composed of a positioning arm (112) having an index mark (114), projecting from the outer periphery of the hollow casing (110) of the cursor device (100).
10. An optical digitizer as set forth in any of claims 3 to 9, characterised in that the optical system comprises a light source (122) emitting the irradiating light, and an optical filter (124) having an optical characteristic such as to cut off light having a wavelength longer than that of the irradiating light.

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11. An optical digitizer as set forth in claim 10, characterised in that the optical system comprises a set of light sources (122A,B) radiating light fluxes having the same wavelength, and a set of optical filters (124A,B) having an optical characteristic such as to cut off light having a wavelength longer than that of the light sources.
12. An optical digitizer as set forth in claim 10 or 11, characterised in that the light source (122) is a light emitting diode of GaP.
13. An optical digitizer as set forth in claim 12, characterised in that the light emitting diode (122) emits light having a peak luminance at a wavelength of 555 nm.
14. An optical digitizer as set forth in any of claims 10 to 13, characterised in that the first optical filter (124) has an optical characteristic such as to cut off light having a wavelength longer than 570 nm.
15. An optical digitizer as set forth in any of claims 10 to 14, characterised in that the sensing means comprise a charge coupled sensor (130).
16. An optical digitizer as set forth in claim 15, insofar as dependent on claim 7, characterised in that the sensing means further comprises a convex lens (126) and a second optical filter (128) having an optical characteristic such as to cut off light having a wavelength shorter than that of the fluorescent light, the convex lens and second optical filter being provided in the path of the fluorescent light to the charge coupled sensor (130).
17. An optical digitizer as set forth in claim 16, characterised in that the second optical filter (128) has an optical characteristic such as to cut off light having a wavelength shorter than 570 nm.
18. An optical digitizer as set forth in any of claims 3 to 17,

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characterised in that the optical recognition means (100) further comprises a switch (140) connected to the sensing means (130) and to a graphic data processor (200).

19. An optical digitizer as set forth in any of claims 3 to 18, characterised in that the optical recognition means (100) further comprises a semiconductor memory (132) for temporarily storing image information sensed by the sensing means (128,130).

20. An optical digitizer as set forth in any of claims 3 to 19, characterised in that the co-ordinate correlative pattern (12) is provided in the form of lattice defined by a plurality of longitudinal and lateral straight lines intersecting with each other.

21. An optical digitizer as set forth in claim 20, characterised in that the spacings both between the longitudinal lines and between the lateral lines are integral multiples of a unit length.

22. An optical digitizer as set forth in claim 21, characterised in that binary digits (ones and zeros) are assigned to respective co-ordinate locations corresponding to the integral multiples of the unit length in the longitudinal and lateral directions of the lattice pattern, depending upon whether the longitudinal and lateral lines exist or not at the respective co-ordinate locations, thus to express the respective co-ordinate locations by code sequences defining a maximum period sequence.

23. An optical digitizer as set forth in claim 22, characterised in that the maximum period sequence is created by a circulating shift register.

24. An optical digitizer as set forth in claim 23, characterised in that the maximum period sequence created by N stages of a circulating shift register is defined by repetition of a bit pattern having a bit length of (2^N-1) , thus creating (2^N-1) kinds of successive N bit codes different from each other.

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25. An optical digitizer as set forth in claim 22, 23 or 24, characterised in that projected image data corresponding to a part of the lattice pattern which falls within the said field of view is sensed by the sensing means.
26. An optical digitizer as set forth in claim 25, in combination with a processor (200) adapted to execute processing for determining position co-ordinates and a rotational angle of the optical recognition means (100) on the light active surface (10), the processing being carried out by finding out data indicative of an arbitrary single straight line from the projected image data corresponding to the part pattern optically sensed by the sensing means (130) to calculate the rotational angle with respect to a longitudinal or lateral line within the said field of view using the data indicative of the arbitrary single straight line, calculating respective spacings between a plurality of longitudinal and lateral lines within the said field of view to determine a corresponding successive N bit code from the respective spacings thus calculated to find out a section to which the centre of the field of view belongs, thus to calculate position co-ordinates of the centre of the field of view.
27. An optical digitizer as set forth in claim 26, characterised in that the processor (200) is operative to execute a further processing for determining position co-ordinates of the graphic data recording medium by using a distance between the centre of the field of view and a predetermined position of the first means (112,114), the rotational angle, and the position co-ordinates of the centre of the field of view.
28. An optical digitizer as set forth in claim 27, characterised in that a sequence comprising the processing and the further processing is periodically executed only while the optical recognition means (100) and the processor (200) are electrically coupled.

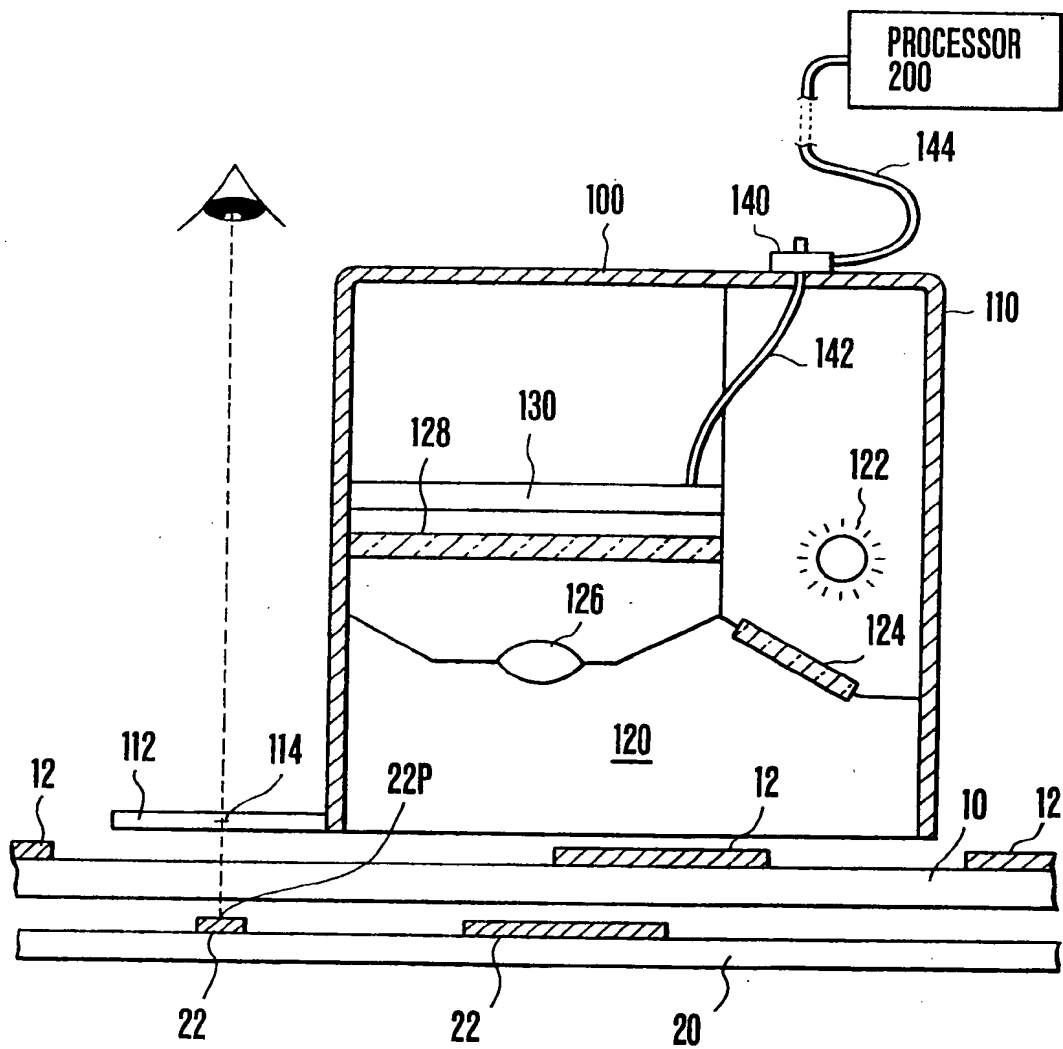


FIG. 1

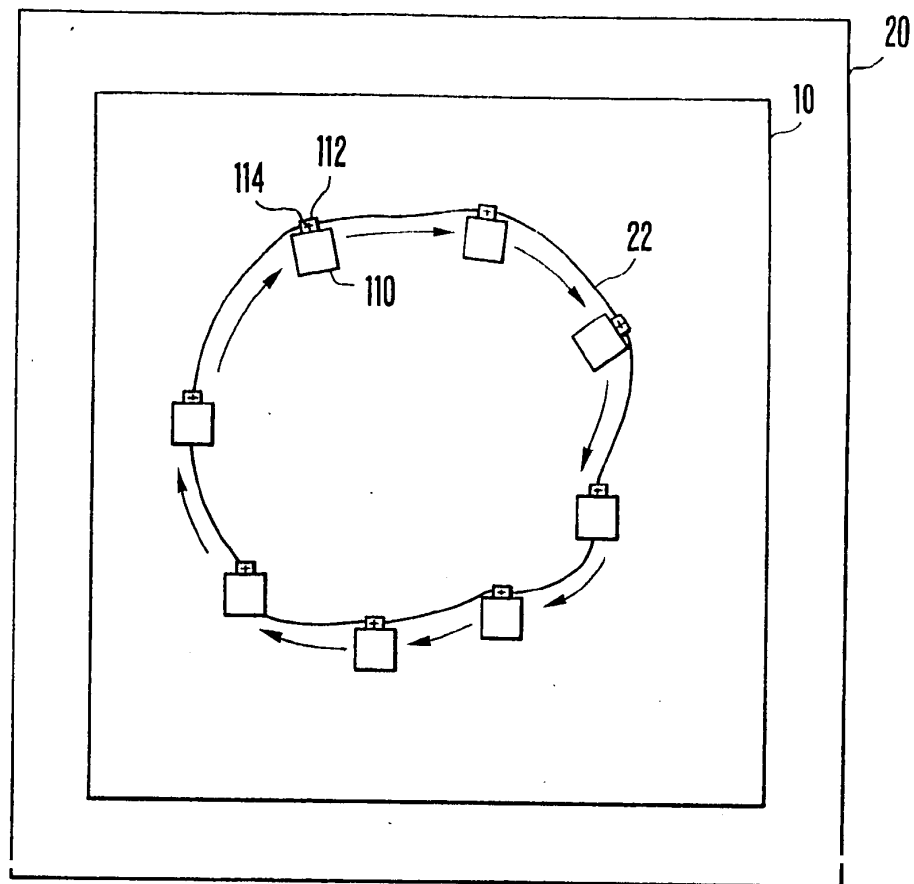


FIG. 2

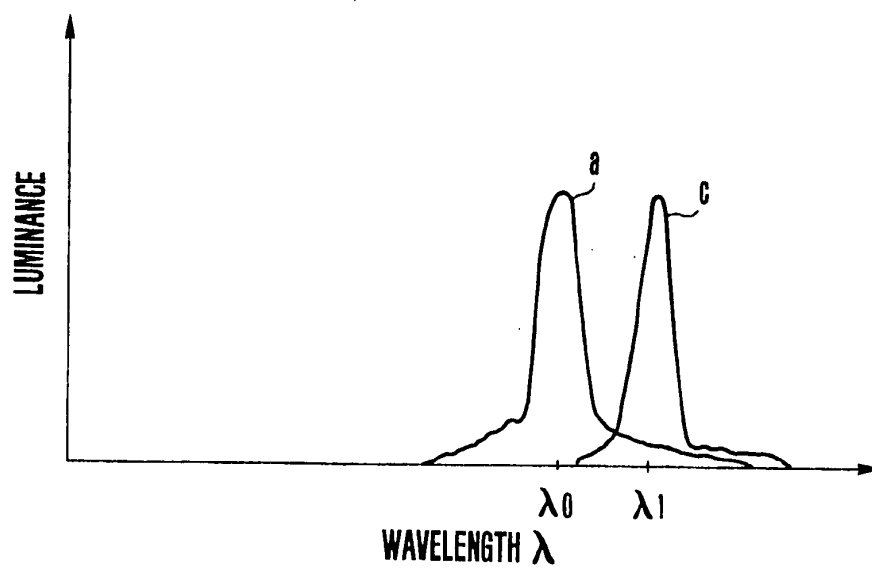


FIG. 3

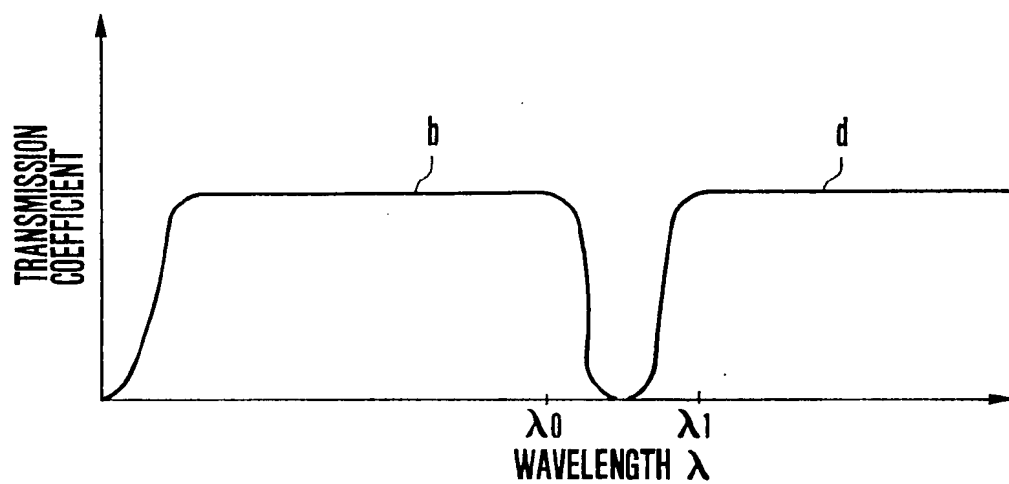


FIG.4

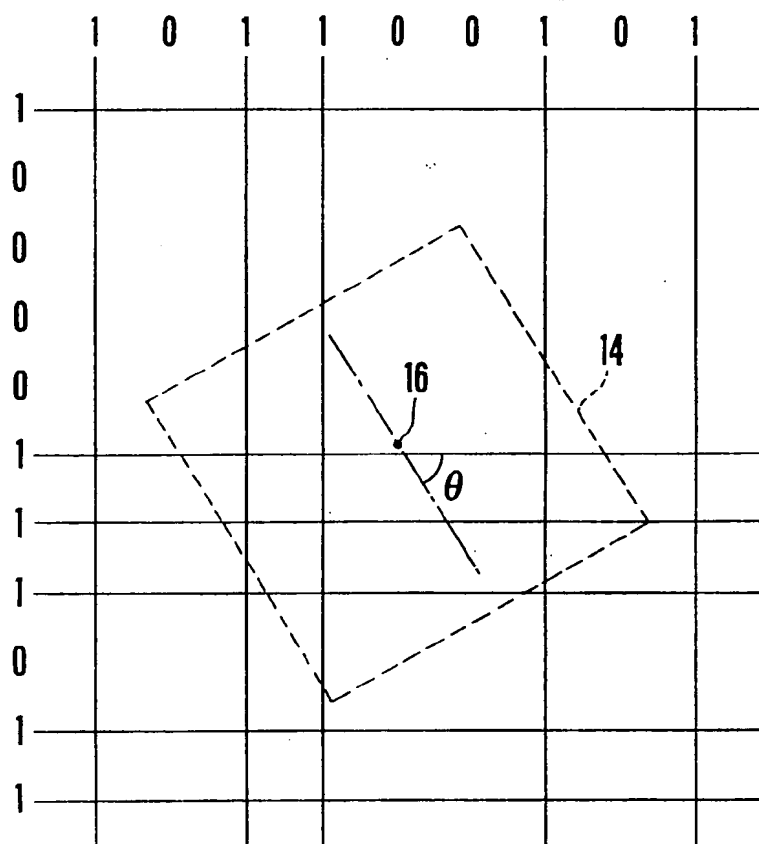


FIG.5

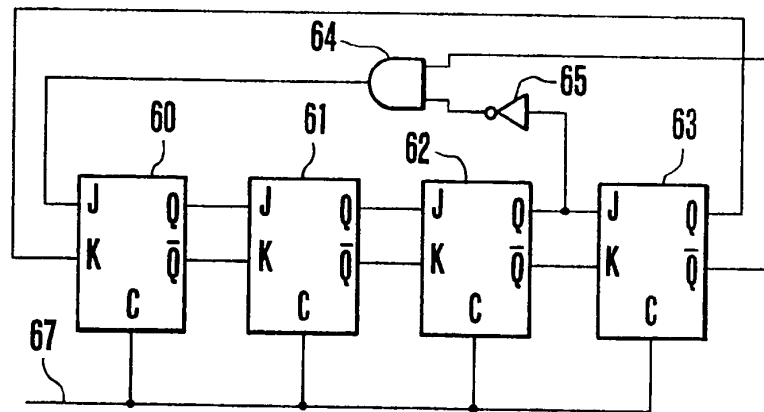


FIG. 6

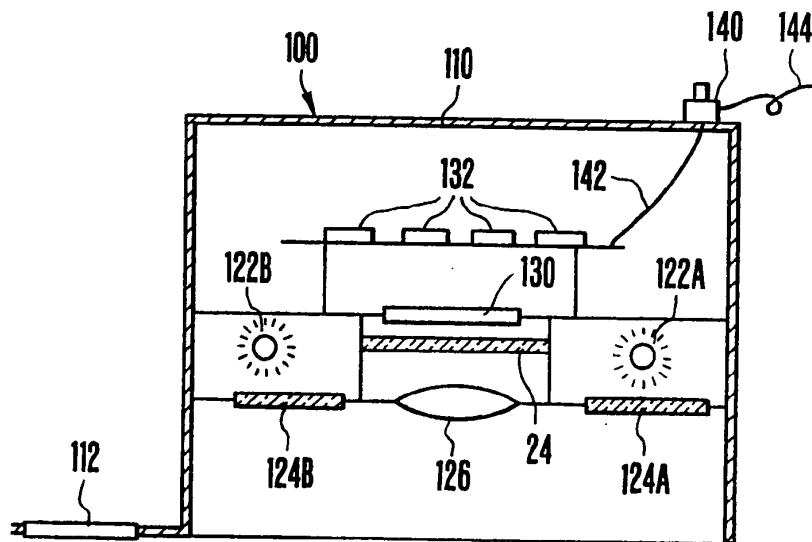


FIG. 7